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NEST SITE CHARACTERISTICS IN THE SONG SPARROW AND PARASITISM BY BROWN-HEADED COWBIRDS

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ABSTRACT.—We studied populations of Song Sparrows (*Melospiza melodia*) on 11 islands near Victoria, British Columbia, to evaluate the relationship between nest site characteristics and parasitism by Brown-headed Cowbirds (*Molothrus ater*). For all nests we recorded their height, the height of vegetation above the nest, the percentage of overhead and side exposure, the number of perches in trees and shrubs within 10 m of the nest, and the distance to the nearest tree or shrub perch. Song Sparrow nests within 10 m of trees were parasitized more often than those farther from trees. Estimates of overhead and side exposure also were lower for parasitized nests than unparasitized nests. Our results support the hypotheses that the proximity of trees, and the amount of concealing cover around host nests, influence the success of cowbirds searching for nests to parasitize. *Received 14 June 2002, accepted 14 December 2002.*

Song Sparrows (*Melospiza melodia*) are among the most common hosts of the Brown-headed Cowbird (*Molothrus ater*; Lowther 1993, Scott and Lemon 1996), and suffer higher nest failure and a lower net reproductive rate when cowbirds are abundant (Arcese et al. 1992, 1996; Smith and Arcese 1994; Arcese and Smith 1999; Smith et al. 2002). Because the reproductive success of Song Sparrows may depend upon their ability to evade detection by cowbirds, we investigated the role of vegetation structures near the nest as potential factors affecting cowbird parasitism.

Hauber and Russo (2000) listed four main hypotheses of cowbird nest-searching behavior, of which we consider two. The Nest Exposure Hypothesis predicts that relatively exposed nests are most likely to be parasitized. Some support for this hypothesis exists (Larison et al. 1998, Moskát and Honza 2000), but other studies found no relationship between vegetative cover and parasitism, or found that the relationship between cover and parasitism varied by study site (Clotfelter 1998, Howe and Knopf 2000, Hauber and Russo 2000). Moskát and Honza (2000) showed that nest exposure and the distance to a suitable perch each were related to the probability of parasitism by Common Cuckoos (*Cuculus canorus*), but suggested that perch proximity was the most influential of these variables.

The Perch Proximity Hypothesis suggests that the ability of cowbirds to locate nests is enhanced when perches are available from which to survey the nesting area. In support of this hypothesis, Hauber and Russo (2000) showed that perch proximity was a positive predictor of the frequency of parasitism by Brown-headed Cowbirds of Song Sparrows. Researchers studying other cowbird hosts have reported similar relationships (e.g., Freeman et al. 1990, Clotfelter 1998).

We studied cowbird parasitism of Song Sparrows on 11 small islands located about 20 km northeast of Victoria, British Columbia, Canada. Our goal was to test if one or more of several variables associated with nest concealment and the proximity of trees or perches in shrubs were related to the frequency of parasitism by cowbirds. We predicted that nests with more overhead and side cover, and fewer perches and trees within 10 m, would be parasitized less often than other nests. We also discuss briefly some implications of our results in the context of our long term study of cowbird parasitism of Song Sparrows on Mandarte Island, British Columbia.

METHODS

Study area.—We attempted to monitor all Song Sparrow nests initiated on 11 islands (centered approximately 48° 38′ N, 123° 17′ W) from April through July, 2001. The 11 islands were Mandarte (8.1 ha), Kerr (2.9 ha), Rubly (2.9 ha), Little Shell (0.6 ha), Reay (0.5

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ha), Dock 1 (0.5 ha), Dock 2 (0.4 ha), Dock 3 (0.2 ha), Strawberry (0.2 ha), Imrie (0.2 ha), and Sidney Spit (0.4 ha). Nesting habitat varied slightly among islands, but most nests occurred in blackberry (*Rubus ursinus* and *R. macrocarpum*), rose (*Rosa nutkana*), snowberry (*Symphoricarpos albus*), or other herbaceous vegetation and grasses. The islands vary in their proximity to other islands and the amount of forest cover. Mandarte Island supports a large colony of Glaucous-winged Gulls (*Larus glaucescens*) and has only a few small, live trees within shrub patches. Kerr and Rubly islands support mature Douglas Fir (*Pseudotsuga menziesii*) forests. Little Shell, Reay, and Dock 1 and 2 have a mix of meadow habitat with several moderately sized trees. Dock 3, Strawberry, Imrie, and Sidney Spit have no trees.

Data collection.—We banded all Song Sparrows with a USFWS band and a unique combination of three colored plastic bands. We visited the territories of all birds every 2–5 days to locate all active nests and record nest contents, nest failure, and parasitism by cowbirds. We found the majority of nests during incubation, and attempted to visit nests only when potential predators or brood parasites were not in view.

After young fledged or nests failed, we placed a 6.5-cm diameter orange ball in the nest cup to estimate the visibility of nests from overhead and side positions, each to the nearest 5%. To estimate "side exposure" we recorded the percentage of the top half of the ball that was visible to a human observer positioned at nest height, at a distance of 1 m, in each of the four cardinal directions. We then summed these records and divided by four to obtain a mean estimate of side exposure from 0 to 100%. We estimated "overhead exposure" as the percentage of the ball visible from 1 m directly above the nest.

We measured nest height to the nearest 1 cm from the ground to the rim of the nest cup, and measured vegetation canopy height to the nearest 1 cm from the ground to the approximate edge of the canopy directly above the nest. We counted the number of perches in shrubs and the number of trees within 10 m of the nest, where trees were defined as live or dead woody vegetation >3 m in height. We defined shrub perches as live or dead branches extending ≥10 cm above the vegetation canopy and large enough to support a perching cowbird (≥15 mm; CAS, PA, KDO pers. obs.). We measured the distance from the nest to the nearest tree or shrub perch to the nearest 10 cm and measured the height of the nearest shrub perch to the nearest 1 cm. All measurements were made ≥10 days following fledging or nest failure, but before the vegetation had changed markedly with respect to the measurements above. Parasitized nests were those known to have received one or more cowbird eggs.

Statistical analyses.—We pooled data for all islands where cowbirds occurred. We excluded Mandarte Island from analyses presented here because intensive censuses and the absence of parasitized nests during the study period suggested that cowbirds did not visit the island. Results of analyses with and without nests from Mandarte Island included were similar. We also excluded nests initiated before cowbirds began laying in the study area because these nests were not susceptible to parasitism.

We used SYSTAT 9.0 for all statistical analyses (Wilkinson 1989). We used two sample *t*-tests to compare heights and distances because these variables were normally distributed. We used Mann-Whitney *U*-tests to compare percentages and counts because they were better suited to these kinds of data (Sokal and Rohlf 2000).

RESULTS

We collected data for 64 nests initiated after the arrival of cowbirds in the study area; 29 (45.3%) of these were parasitized. The probability of parasitism was positively related to nest exposure and the proximity of trees (Table 1). Unparasitized nests were less exposed than parasitized nests from both side and overhead views; however, the difference was significant only for side exposure. Distance to the nearest shrub perch was similar for parasitized and unparasitized nests, but parasitized nests were significantly closer to trees than unparasitized nests. The number of shrub perches within 10 m of nests was unrelated to parasitism, but there were nearly twice as many trees within 10 m of parasitized than unparasitized nests (Table 1). Only one parasitized nest had no trees within 10 m. Vegetation and

TABLE 1. Vegetation characteristics for 64 parasitized (n = 29) and unparasitized (n = 35) Song Sparrow nests on 10 islands (Mandarte Island excluded; see Methods) near Victoria, British Columbia. Parasitized nests were more exposed from the side and closer to trees than unparasitized nests. Values are means (SDs) and are compared by two-sample Mann-Whitney U-tests (exposure, number) or t-tests (distance, height). P-values are two-tailed and adjusted (×8) for the number of related tests.

Variable	Unparasitized	Parasitized	Test statistic (U or t)	P
Exposure (%)				
Overhead	23.4 (28.1)	42.1 (31.7)	2.50	0.120
Side	15.2 (13.6)	28.0 (19.5)	3.06	0.024
Distance (m)				
Shrub Perch	1.8 (1.8)	1.7 (1.8)	0.23	1.000
Tree	5.8 (2.5)	3.6 (2.4)	3.02	0.032
Number (within 10 m)				
Shrub Perches	8.2 (6.3)	11.5 (9.5)	1.63	0.872
Trees	2.5 (3.4)	4.7 (4.7)	2.21	0.248
Height (m)				
Nest	0.4 (0.4)	0.5 (0.4)	1.70	0.752
Vegetation	1.2 (0.5)	1.4 (0.8)	1.00	1.000

nest height were similar for parasitized and unparasitized nests (Table 1).

DISCUSSION

Our results support the Nest Exposure Hypothesis because well concealed Song Sparrow nests were parasitized less often, particularly those concealed from side views. Larison et al. (1998) also found that Song Sparrow nests within 1 m of the ground and with abundant lateral cover were parasitized less often than other nests, and suggested that the presence of dense lateral cover might conceal the movements of hosts near their nests and reduce the chance of detection by searching cowbirds. Our results are consistent with this suggestion. Strausberger (1998) suggested that cowbirds sometimes search for nests by hovering over the nest area, and many authors have suggested that cowbirds locate nests by observing hosts near their nest (see Hauber and Russo 2000). Our results strengthen the idea that the amount of cover near nests affects the ability of cowbirds to find them.

It is likely, however, that cowbirds use a variety of methods to find nests, and that the success of various methods or the frequency with which cowbirds employ them may differ with the type of habitat or host, or the density of hosts or cowbirds (Arcese et al. 1996, Brittingham and Temple 1996, Strausberger 1998, 2001). It is interesting that Hauber and Russo (2000) found no relationship between parasitism and the visibility of Song Sparrow nests in New York. In earlier work on Mandarte Island, Smith (1981), using a qualitative index of concealment (0–6 for completely exposed to concealed nests), suggested that parasitized nests were slightly, but not significantly, more exposed than unparasitized nests. Uyehara and Whitfield (2000) also found no relationship between nest concealment and parasitism in Southwestern Willow Flycatchers (*Empidomax traillii extimus*), where 57% of nests were parasitized. It is possible that high cowbird densities result in a higher percentage of host nests being parasitized and reduce the effect of vegetation cover (Robinson et al. 1995, Robinson and Smith 2000).

Our finding of a positive relationship between the proximity of trees and parasitism is consistent with earlier results of Clotfelter (1998) and Hauber and Russo (2000), and supports the Perch Proximity Hypothesis. However, Hahn and Hatfield (1995) found higher rates of parasitism in forest interior than in field or edge habitat and suggested that trees enhanced the ability of cowbirds to detect potential hosts without being detected themselves. Strausberger and Horning (1998), Strausberger (2001), and Strausberger and Burhans (2001) also have suggested that trees

provide vantage points from which cowbirds can observe nests undetected, and thereby avoid aggressive nest defense by hosts or lessen their rate of nest desertion. Song Sparrows often cease nest building when cowbirds are near (Arcese et al. 1996). Thus, the fact that we did not find a positive relationship between the presence or proximity of shrub perches and parasitism, but did find a positive relationship with the proximity to trees, suggests that trees are more important for the concealment that they provide than as vantage points. Clotfelter (1998) also noted that although proximity to trees was related to parasitism in Red-Winged Blackbirds (*Agelaius phoeniceus*), the number of perches near parasitized and unparasitized nests were similar.

Finally, we excluded from our analysis nests on Mandarte Island because the absence of cowbirds there during this study meant that nests were not at risk of parasitism. Since the colonization of the island by cowbirds between 1960 and 1975 (Smith and Arcese 1994), there has been a marked decline both in the number of trees on the island and the frequency of visits and rate of parasitism by cowbirds (CAS, PA, KDO unpubl. data). Given our current results, we suggest that Mandarte Island has become less attractive to cowbirds as the number of trees have declined and the vegetation structure has become less conducive to nest searching by cowbirds. This hypothesis predicts that tree encroachment into grasslands and old fields may increase the rate of parasitism in these habitats.

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LITERATURE CITED

Arcese, P. and J. N. M. Smith. 1999. Impacts of nest predators and brood parasites on the production of North American passerines. Pp. 2953–2966 *in* Proc. XXII Int. Ornithol. Congr., Durban (N. J. Adams and R. H. Slotow, Eds.). BirdLife South Africa, Johannesburg.

Arcese, P., J. N. M. Smith, and M. I. Hatch. 1996. Nest predation by cowbirds and its consequences for passerine demography. Proc. Natl. Acad. Sci. 93:4608–4611.

Arcese, P., J. N. M. Smith, W. M. Hochachka, C. M. Rogers, and D. Ludwig. 1992. Stability, regulation, and the determination of abundance in an insular Song Sparrow population. Ecology 73: 805–822.

Brittingham, M. C. and S. A. Temple. 1996. Vegetation around parasitized and non-parasitized nests within deciduous forest. J. Field. Ornithol. 67: 406–413.

Clotfelter, E. D. 1998. What cues do Brown-headed Cowbirds use to locate Red-winged Blackbird host nests? Anim. Behav. 55:1181–1189.

Freeman, S., D. F. Gori, and S. Rohwer. 1990. Red-winged Blackbirds and Brown-headed Cowbirds: some aspects of a host-parasite relationship. Condor 92:336–340.

Hahn, D. C. and J. S. Hatfield. 1995. Parasitism at the landscape scale: cowbirds prefer forests. Conserv. Biol. 9:1415–1424.

Hauber, M. E. and S. A. Russo. 2000. Perch proximity correlates with higher rates of cowbird parasitism of ground nesting Song Sparrows. Wilson Bull. 112:150–153.

Howe, W. H. and F. L. Knopf. 2000. The role of vegetation in cowbird parasitism of Yellow Warblers. Pp. 200–203 *in* Ecology and management of cowbirds and their hosts (J. N. M. Smith, T. L. Cook, S. I. Rothstein, S. K. Robinson, and S. G. Sealy, Eds.). Univ. of Texas Press, Austin.

Larison, B., S. A. Laymon, P. L. Williams, and T. B. Smith. 1998. Song Sparrows vs. cowbird brood parasites: impacts of forest structure and nest-site selection. Condor 100:93–101.

Lowther, P. E. 1993. Brown-headed Cowbird (*Molothrus ater*). No. 47 *in* The birds of North America (A. Poole and F. Gill, Eds.). Academy of Natural Sciences, Philadelphia, Pennsylvania, and the American Ornithologists' Union, Washington, D.C.

Moskát, C. and M. Honza. 2000. Effect of nest and nest site characteristics on the risk of Cuckoo *Cuculus canorus* parasitism in the Great Reed Warbler *Acrocephalus arundinaceus*. Ecography 23: 335–341.

Robinson, S. K., F. R. Thompson, T. M. Donovan, D. R. Whitehead, and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. Science 267:1987–1990.

Robinson, S. K. and J. N. M. Smith. 2000. Environmental correlates of cowbird parasitism at multiple spatial scales. Pp. 195–199 *in* Ecology and management of cowbirds and their hosts (J. N. M. Smith, T. L. Cook, S. I. Rothstein, S. K. Robinson, and S. G. Sealy, Eds.). Univ. of Texas Press, Austin.

Scott, D. M. and R. E. Lemon. 1996. Differential reproductive success of Brown-headed Cowbirds with Northern Cardinals and three other hosts. Condor 98:259–271.

SMITH, J. N. M. 1981. Cowbird parasitism, host fitness, and age of the host female in an island Song Sparrow population. Condor 83:152–161.

SMITH, J. N. M. AND P. ARCESE. 1994. Brown-headed Cowbirds and an island population of Song Sparrows: a 16-year study. Condor 96:916–934.

SMITH, J. N. M., M. J. TAITT, AND L. ZANNETTE. 2002. Removing Brown-headed Cowbirds increases seasonal fecundity and population growth of Song Sparrows. Ecology 83:3037–3047.

SOKAL, R. R. AND F. J. ROHLF. 2000. Biometry, 5th ed. W. H. Freeman, New York.

STRAUSBERGER, B. M. 1998. Evident nest-searching behavior of female Brown-headed Cowbirds while attended by males. Wilson Bull. 110:133–136.

STRAUSBERGER, B. M. 2001. The relationship of habitat and spatial distribution of nests with Brown-headed Cowbird parasitism of Red-winged Blackbirds. Wilson Bull. 113:129–133.

STRAUSBERGER, B. M. AND D. E. BURHANS. 2001. Nest desertion by Field Sparrows and its possible influence on the evolution of cowbird behavior. Auk 118:770–776.

STRAUSBERGER, B. M. AND M. E. HORNING. 1998. Response of nestling Song Sparrows (*Melospiza melodia*) and Red-winged Blackbirds (*Agelaius phoeniceus*) to models of parasitic cowbirds and nonthreatening towhees. Bird Behav. 12:71–78.

UYEHARA, J. C. AND M. J. WHITFIELD. 2000. Association of cowbird parasitism and vegetative cover in territories of Southwestern Willow Flycatchers. Pp. 204–209 *in* Ecology and management of cowbirds and their hosts (J. N. M. Smith, T. L. Cook, S. I. Rothstein, S. K. Robinson, and S. G. Sealy, Eds.). Univ. of Texas Press, Austin.

WILKINSON, L. 1989. SYSTAT: the system for statistics. SYSTAT, Evanston, Illinois.